

‘Aliens’, ‘Natives’ and ‘Artificial Habitat’- Revisiting the Legacies of H.C. Watson and S.T. Dunn

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Abstract

Hewett Cottrell Watson, a British botanist and phyto-geographer, might rightfully be the first to apply the term ‘alien’ to denote ‘foreign’ species introduced to Britain, which successfully established at various locations in the isles with or without man’s help. Botanists recognize Watson for his monumental work *Cybele Britannica*, written in four volumes over 12 years (1847-1859). While applying the term ‘alien’, along with ‘natives’ (indigenous species), ‘denizens’ (long-term residents, introduced species, who might be considered ‘naturalized’) and ‘colonists’ (species, colonizing agricultural land and habitat occupied by humans), Watson discussed in detail how difficult it is to assign ‘nativeness’ to any species.

Stephen Troyte Dunn, who wrote *Alien Flora of the British Isles* in 1905, partly adopted H. C. Watson’s categorization of species. Both worked without much knowledge of the geological and fossil evidence of plants but agreed that all species, even ‘natives’, may have been immigrants sometime in the past. All of Watson and Dunn’s ‘alien’ species have several things in common. They are all highly productive (fertile), pioneering or colonizing taxa, which can establish and thrive in disturbed environments (‘artificial habitat’, *sensu* S. T. Dunn), from which they perpetuate themselves.

Knowledge about the ‘foreign’ components of a country’s flora is ecologically important to understand how species adapt to new environments and influence others. Both Watson and Dunn emphasized the remarkable ability of some introduced to spread, unassisted by man’s activities, while others, like ‘*shadows of men*’, appear to ‘*follow the plough*’.

The ‘colonization process’ of these highly successful plants gets them into trouble in the minds of some, who prefer to attribute other meanings, such as ‘invasions’ to these “foreign” species. A dip into history shows that Watson and Dunn discussed introduced plants without disparaging them. Like humans, colonizing taxa are good at what they are genetically predisposed to do, i.e., adapt and survive even under stressful environments. They are no more ‘alien’ than we are. They are also no more ‘invasive’ than we are. As one historian (Alfred Crosby) noted, these species may even help heal the wounds on the earth, torn apart by the real ‘invaders’ – those ‘*wretched ingrates*’ (humans).

Keywords: ‘Aliens’; H. C. Watson; S. T. Dunn; ‘invasive species’; invasions; weeds

Opening

“...As the aborigines disappeared with the advance of the whites, so do the native plants generally yield their possessions as cultivation extends, and the majority of the plants to be met along the lanes and streets of villages, and upon farms, are naturalized strangers, who appear to be quite at home, and are with difficulty to be persuaded or driven away...”

William Darlington (1859, p. xiii)

“...Weeds were crucially important to the prosperity of the advancing Europeans and Neo-Europeans. The weeds, like skin transplants placed over broad areas of abraded and burned flesh, aided in healing the raw wounds that the invaders tore in the earth. The exotic plants saved newly bared topsoil from water and wind erosion and from baking in the sun. And the weeds often became essential feed for exotic livestock, as these, in turn, were for their masters. The colonizing Europeans who cursed their colonizing plants were wretched ingrates...”

Alfred Crosby (1986, p. 170)

"...Man is everywhere a disturbing agent. Wherever he plants his foot, the harmonies of nature are turned to discords. The proportions and accommodations which insured the stability of existing arrangements are overthrown..."

"...Indigenous vegetable and animal species are extirpated, and supplanted by others of foreign origin, spontaneous production is forbidden or restricted, and the face of the earth is either laid bare or covered with a new and reluctant growth of vegetable forms, and with alien tribes of animal life..."

George Perkins Marsh, 1864 (1867, p. 36)

"...Whenever man has transported a plant from its native habitat to a new soil, he has introduced a new geographical force to act upon it, and this generally at the expense of some indigenous growth which the foreign vegetable has supplanted..."

"...The new and the old plants are rarely the equivalents of each other, and the substitution of an exotic for a native tree, shrub, or grass increases or diminishes the relative importance of the vegetable element in the geography of the country to which it is removed...."

George Perkins Marsh, 1864 (1867, p. 58)

In a previous Editorial (Chandrasena, 2020), I analyzed some not well-known ideas of several key 19th Century individuals - William Darlington (1859), Gerald McCarthy (1892) and Asa Gray (1879), which were fore-runners to the development of *Weed Science* in the 20th Century. All three examined and dealt with agricultural weeds in the USA.

As shown in Darlington's quote, many plants introduced by humans across the continents '*take possession*' and settle in the new environments and are then '*hard to be persuaded to leave*'. Darlington was entirely correct. The metaphor he used - that of '*newly-arriving*' white Europeans driving the Native Americans away in the American West, was powerful, although perhaps a little overblown. History shows that newly introduced plants, whether in the Americas or elsewhere, did not permanently displace native indigenous plants. Instead of complete displacement, plant species appear to have an uncanny ability to adjust their lifestyles, ecological niches and co-exist.

Their interactions are subtle but never '*do-or-die*' battles (pardon my use of the war rhetoric).

George Perkins Marsh's astute observations in his voluminous treatise (1864) remind us of the destabilizing effects of humans on Nature. Marsh spent considerable time explaining how humans transfer species from one place to another, modify the environment, extirpate some plant and animal species while favouring others. These quotes above are a fitting preamble to this essay.

I am thankful for the environmental history books: '*Ecological Imperialism*' by Alfred Crosby (1986), '*War on Weeds In The Prairie West*' by Clinton Evans (2002), '*Weeds: An Environmental History of Metropolitan America*' by Zachary Falck (2010), and Marcus Hall's Editorial (2003) which are essential reading in this regard.

Understanding our cultural relationships with weeds will equip weed scientists worldwide to deal better with weeds. *We must constantly remind ourselves that, ecologically speaking, and for all intents and purposes, the term 'weeds' is a synonym for 'pioneering' or 'colonizing' species* (see Bunting, 1960; Baker, 1965).

Much has already been written about how man was the '*primary agent*' in spreading plants and animals across continents. These were either by purposeful introductions, for economic benefits, or by the way of unintentional, incidental, and careless introductions (Watson, 1847-59; 1870; Darlington, 1859; Gray, 1879; Dunn, 1905; Crosby, 1986; Evans, 2002; Falck, 2010). Instead of focusing on the human agent as the culprit, the '*invasive aliens*' narrative tends to blame some plant species as '*guilty, until proven innocent*' – words chosen to unnecessarily create fear and apprehension in the public's mind ¹.

In the 17th, 18th, and 19th Centuries, when the focus of the naturalists and plant explorers was on plants of ornamental, horticultural or economic values, no one gave much thought to the colonizing attributes of any species. The capacity of any species to establish itself in a new environment, without much help from man, was regarded as an admirable quality.

No one probably understood these innate capabilities until Darlington (1859) and Gray (1879) made those remarks regarding specific species. Observations from continental Europeans, including Alphonse de Candolle (1855) and Albert Thellung (1912), are noteworthy. Perhaps, Jethro Tull (1762) should also be credited in this regard because he

¹ The often quoted article by Jason Van Driesche & Roy Van Driesche with the provocative title: "*Guilty Until Proven Innocent*" first appeared in the *Conservation in Practice Magazine*, Vol. 2 (1): 8-18.

The Magazine is no longer published but has been replaced by the *Anthropocene Magazine*, published at University of Colorado, Boulder, Colorado, USA.

wrote specifically about 'weeds' nearly 260 years ago. Promoting his agricultural invention, Tull's book-*Horse-Hoeing Husbandry or An Essay on the Principles of Vegetation and Tillage*, appreciated weeds. In *Chapter VII – Of Weeds* (p. 73), Tull discussed the strengths of many weedy species, calling them 'noxious' (*herbae noxiae*). However, his 18th Century tome was not on introduced species.

As discussed in detail by Crosby (1986), Evans (2002) and Falck (2010), species were introduced to North America for societal benefits, primarily by Europeans. The enthusiastic introducers wished that the plants would establish themselves and may not need looking after. While not all species were successfully established, many did, and those were species with colonizing abilities.

Success in their 'new environments' expanded the bio-geographical ranges of many of these remarkable species. Their genetic make-up and innate capacities, related to fecundity, lifecycle strategies, adaptations for stress tolerance and wide ecological amplitudes, are among the reasons why they are so successful. Once introduced, as Crosby (1986) stated (see quote above), '*these species help heal the wounds on the earth, torn apart by the real 'invaders' – those 'wretched ingrates' (humans).*

After the initial introductions, humans continue to be helpful by being wholly or partially responsible for creating disturbances, enabling many such colonizing taxa to entrench themselves away from their native ranges successfully. Darlington's astute observation (1859, p. xiii) on these extraordinarily successful colonizers is also spot-on: '*once they are fully established, they will not yield without an argument*'.

'Alien' – The Origin of a Term

In this essay, I aim to discuss how the term '*alien*' came to be applied to plants introduced from one country to another. The earliest proponent - Hewett Cottrell Watson (1804-1881), an eminent English botanist and phyto-geographer, was indeed the most significant figure in this regard. '*Alien*' is one category Watson used to assign plants to, alongside other terms - '*native*', '*denizen*', '*colonists*', and '*casuals*'. The categorization is discussed in detail in his *Cybele Britannica* (Watson, 1845-1859).

The word '*alien*' (Latin, "*alienus*") means "*foreign*", "*belonging to another*", or "*unfamiliar*". The term used as a noun arose in the 13th or 14th Century. When the verb '*alienate*' first appeared, it was a legal term in the mid-15th Century, which was used in transferring the ownership of some property over to someone else, so that it became now "*foreign*" or "*unconnected*" to the transferee.

In a legal sense, it was applied to people "*residing in a country not of one's birth*". The on-line etymology dictionary (<https://www.etymonline.com/>) indicates that the sense of "*wholly different in nature*" is from the 1670s. The term '*alien*' then evolved further and was first recorded to mean "*not of this earth*" around 1920. It is now very much a common term used in science fiction.

Marcus Hall² pointed out that the term '*alien*' was applied in Britain to ascribe a 'civil status' in the past centuries. The Royal Office maintained an "*Aliens Office, Home Office*" to keep track of immigrants and their origins from 1793-1836³ In Britain, the '*Aliens Act*' was established in 1793 to "*regulate the growing numbers of refugees fleeing to Britain to escape the French Revolution, and to address the fear that enemy spies might infiltrate Britain during the Napoleonic Wars*"⁴. It seems very likely that H. C. Watson borrowed from some of this terminology.

Steven Troyte Dunn, another English botanist, who worked at London's Kew Herbarium, and at various overseas stations of the Empire, captured Watson's ideas about '*aliens*' and '*natives*' when he wrote '*Alien Flora of The British Isles*' in 1905. I agree with Marcus Hall's view (*pers. comm.*, Oct 2020) that Dunn's use of the term in the book's title may have put an authoritative stamp on the word.

Although Edward Salisbury (1961), a botanist in post-World War II Britain, wrote "*Weeds & Aliens*", we may discount this book, as it is hardly a botanical treatise. In more recent times, in Australia, Peter Michael (1994) used Watson's terminology in a helpful chapter he wrote on the *Australian Vegetation* (see Michael, 1994).

In the following sections, I review the above historical uses of the term '*alien*' as applied to '*introduced plants*', briefly contrasting it with another controversial and dubious term, '*native*'.

² Marcus Hall, Environmental Historian (Institute of Evolutionary Biology & Environmental Studies, University of Zurich).

³ See: The National Archives, "Aliens Office & Home Office: Aliens' Entry Books" (<http://discovery.nationalarchives.gov.uk/details/r/C8869>).

[nationalarchives.gov.uk/details/r/C8869](http://discovery.nationalarchives.gov.uk/details/r/C8869)).

⁴ See: BBC History. Aliens arriving in Britain swore declarations at their port of entry. (http://www.bbc.co.uk/history/familyhistory/bloodlines/migration.shtml?entry=aliens_act&theme=migration).

H.C. Watson's '*Aliens*'

When botanists adopted and applied the term '*alien*' to describe a particular plant species in the mid-19th Century, they intended no derision of any introduced species. H. C. Watson (Figure 1) was among the first to use the term in categorizing what he called the '*civil status*' of plants. Watson's monumental treatise, provocatively named – *Cybele Britannica* - was published in four volumes, which spanned 12 years (1847 to 1859).

In Volume I, Watson (1847, p. 1) clarified that phyto-geography traces out the history and distribution of plants in different geographical positions of countries, their conditions of climate, and the physical peculiarities of their surface. However:

"...the Cybele was about Geographical Botany, which begins with the plants themselves, whether by individual species, or in generic or ordinal groups, and is concerned about the distribution of plant species or groups over the surface of the earth..."

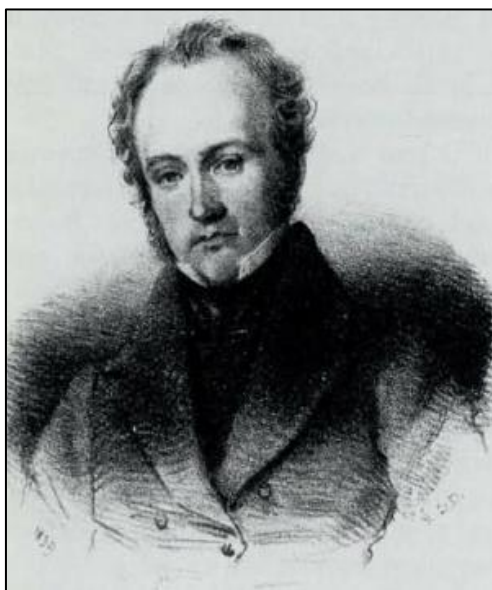


Figure 1H. C. Watson- from a sketch by an artist, published in *The Naturalist* (Feb 1939) [Source: Eggerton, 1979]

Watson deeply regretted the time lapse of 12 years in completing his phyto-geographical works and the '*piecemeal*' nature of the '*successive instalments*'. In the "Postscript" (quote below), he admitted that both phyto-geography and his ideas have changed over that period Watson, 1859, Vol. 4, p. 550):

"...During the full dozen years of interval, neither phytography nor phyto-geography have stood still. Nor have the author's own ideas and inspirations been quite unchangeable during the same period..."

In Volume I, Watson (1847, p. 2) explained that his book was not just a mere catalogue of plants and preferred the term *Cybele* (pronounced: *Sib-el-ee*), invoking a Greek goddess of Nature ⁵:

"...The author ventures, therefore, to substitute the mythological name of Cybele; that is, the name of a Goddess who was supposed to preside over the productions of the earth..."

"...The name of 'Flora' has long been used for those catalogues of plants, in which are described the species of any definite section of the earth; that of 'Cybele' appeals quite as applicable to one which is intended to show their relations to the earth, as local productions of the ground and climate..."

In the four volumes of *Cybele* and the subsequent *Compendium* (Watson, 1870), Watson enumerated about 1428 species, a figure much less than 1500-1600 species that previous botanists had documented. Darwin (1859, p. 63) noted in the *Origin of Species* how Watson declined to recognize some varieties as distinct species, which explains the reduced number of species in the *Cybele*:

"...Mr. H. C. Watson, to whom I lie under deep obligation for the assistance of all kinds, has marked for me 182 British plants, which are generally considered as varieties, but which have all been ranked by botanists as species; and in making this list, he has omitted many trifling varieties, but which nevertheless have been ranked by some botanists as species, and he has entirely omitted several highly polymorphic genera..." Darwin (1859, p. 63) ⁶

In the *Cybele* (Figure 2), Watson's objective was first to categorize and then assign British plants according to their known geographical distributions in the isles. In so doing, he was somewhat obsessed with determining where the species he encountered originated; whether they should be treated, either as '*indigenous natives*' or those that had been '*introduced*' by humans, from various countries, such as Europe, Asia and the Americas.

⁵ *Cybele* - a nature goddess of ancient peoples of Phrygia (an ancient country of Asia Minor) (Source: <https://www.dictionary.com/browse/cybele>).

⁶ Darwin's *Origin of Species* first published in 1859;

2nd Edition (1860); 3rd Edition published in 1909, celebrating 100 years of Darwin's birth Available at: (<https://archive.org/details/originofspecies00darwuoft/page/420/mode/2up?q=watson>).

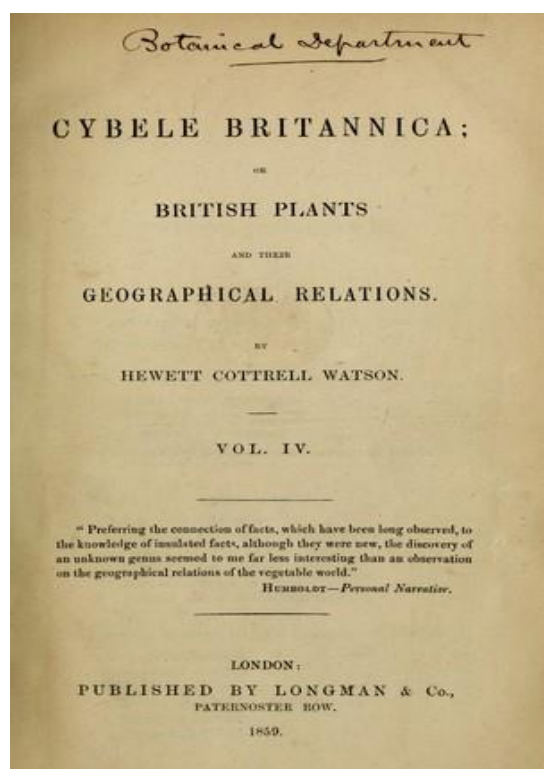


Figure 2 *The Cybele, an image of the front page of the original published Volume I*

To describe the species, Watson borrowed several terms from the legal profession. In his words: *'to explain the 'civil status' and local situations'* and the origins of the British flora. The following quote is from the *Compendium to the Cybele*, in 1870:

"...A series of terms, drawn from our own legal and social classifications, has been used to express the various grades of uncertainty or belief with respect to those plants whose aboriginal nativity is more or less unsettled.

"...The terms 'native, denizen, colonist, alien, casual' serve to express a descending series, from the 'truly wild' and pre-historically established species, down to the occasional stragglers from cultivation, or the products of seeds, accidentally imported with merchandise, ship-ballast, or otherwise..."

"...The word "naturalized" has been variously and carelessly applied by botanical writers that it has ceased to carry with it an exact signification. It ought to mean a species originally introduced by man, but now become thoroughly established, by seed or otherwise, among the native plants of the country, and existing without human aid in sowing its seeds or in preparing the ground for them..."

The range of terms Watson used indicated the doubts he had about the possible origins of species. In Volume I, his categories included the term *'incognito'*, which was replaced by *'casuals'* in 1870.

Egerton (2003), Watson's biographer, suggested that treated as controversial in the mid-1850s, the *Cybele* was possibly overshadowed by Charles Darwin's colossal, *Origin of Species* (Darwin, 1859), which was published simultaneously as Watson's Volume 4, i.e. 1859. The *Cybele* also posed many challenges to botanists of the era as Watson spent a great deal of space in the four volumes criticizing others for just creating dubious lists of plant species.

In *Cybele* Volume I, Watson (1847) defined 'alien plants' as those: *'now more or less established but either presumed or certainly known to have been originally introduced by the human agency from other countries'*. Along with the term 'alien', in the *Cybele* Vol. I, Watson, described several other categories, which are given in Table 1, with some descriptions reduced for brevity.

Watson did not provide the naming authorities of any of the species he described, although botanical names and naming rules were reasonably well established at that time after the Linnaean system of botanical nomenclature ⁷. Botanical names with naming authorities did appear in the later Volume- the *Compendium* (Watson, 1870). To understand which species Watson was referring to, I have included the common names of the species. In subsequent works, in the *Compendium* (Watson, 1870), he replaced the term *'incognito'* with *'casuals'* (see below).

In summing up the four Volumes, on the 'native' status of species, Watson reiterated his doubts:

"...It can rarely or never be known whether the species existed in Britain before mankind, or have immigrated into this country more recently; and if the latter, whether their immigration has been effected by natural means of transport only, as distinguished from those afforded to them by the human agency..."

"...It is possible that none of these species was aboriginal natives on the present surface of Britain. It may be that all of them were immigrants into the British islands, at different dates, from other lands; those lands, or some of them, having subsequently ceased to be. Such uncertainties belong at present rather to geological than to geographical botany..."

⁷ See: Car Linnaeus and binomial plant names – (https://en.wikipedia.org/wiki/Carl_Linnaeus)

Table 1 Watson's Plant Categories given in the *Cybele*, Volume 1 1847 (p. 63) and the *Compendium* (1870) # ##

Term	Description
'Native'	Apparently, an aboriginal British species there being little or no reason for supposing it to have been introduced by human agency. (e.g., heather – <i>Calluna</i> spp.; English daisy - <i>Bellis</i> spp.).
'Denizen'	a species that can behave as a 'native', at present, maintaining its habitats without man's aid, yet, yet liable to some suspicion of having been originally introduced (e.g., orange balsam- <i>Impatiens fulva</i>; sweet violet- <i>Viola odorata</i>).
'Colonist'	- A weed of cultivated land or about houses, and seldom found except in places where the ground has been adapted for its production by the operations of man with some tendency. They also appear on shorelines, disturbed grounds, landslips, etc. (e.g., pheasant's eye- <i>Adonis</i> spp.; poppy- <i>Papaver</i> spp.; corncockle- <i>Agrostemma githago</i>; sweet clover- <i>Melilotus leucantha</i>). <i>With a tendency also in some of them to appear on the shores landslips, and in what are called "waste places". Ranunculus arvensis, Papaver dubium, Thlaspi arvense, Centaurea cyanus, Alopecurus agrestis are weeds of cultivated land; and would perhaps disappear if plough and spade ceased their work #. Several Chenopodia, Mercurialis annua, Rumex pulcher, Lepidium rudemle, Asperugo procumbens, and others constitute connecting links between the 'Colonists' and 'Denizens', found chiefly by roadsides, rubbish heaps, dunghills, and near the sea #</i>
'Alien'	- Now more or less established, but either presumed or certainly known to have been originally introduced from other countries (e.g., <i>Sempervivum</i>; <i>Mimulus</i>; <i>Hesperis</i>; <i>Camelina</i>) ##. 'Aliens' are species certainly or very probably of foreign origin, although several in this category are now well established amid the indigenous flora of this island; others less perfectly so #.
'Incognito'	- Reported as British but requiring confirmation as such. Some of these have been reported through mistakes of the species, such as grass-leaved buttercup- <i>Ranunculus gramineus</i>. Others may have been temporary stragglers in gardens, such as trumpet gentian- <i>Gentiana acaulis</i>. - A few may have existed for a time and become extinct, such as alpine coltsfoot- <i>Tussilago alpina</i>. It is not improbable that some of these may yet be found again. A few may have existed for a time and become extinct, such as prickly parsnip- <i>Echinophora spinosa</i>.
'Casual'	Casual species are chance 'stragglers' from cultivation; those occasionally imported and sown with agricultural seeds; those introduced among wool, oil-seeds, or other merchandise; foreign plants found on ballast heaps deposited from ships; and generally, such alien species are most uncertain in place or persistence #
'Hibernian'	Native, or apparently so, in Ireland, or the Channel Isles, though not found in Britain proper

See text for details. In the *Compendium* to the four earlier volumes of *Cybele*, published in 1870, Watson updated and slightly modified his earlier descriptions of the categories. These are given in italics.

From the descriptions in the *Cybele*: [*Sempervivum tectorum* L. (p. 403; succulent, introduced from America); monkeyflower – *Mimulus* sp. (probably, *M. guttatus* Fisch. Ex DC., introduced from America); Dame's violet - *Hesperis matronalis* L. (p. 157, Eurasian species, introduced to Britain in the 17th Century); false flax [*Camelina sativa* (L.) Crantz] (p. 134, found in ballast heaps; introduced to the UK from Russia and Eastern Europe in the 19th Century).

Watson used the term 'alien' interchangeably with 'introduced species', which were relatively recent arrivals in the British Isles, possibly in the past few centuries. He also drew a sharp contrast between the 'aliens' with species, considered 'natives' of the isles.

The lengthy discussions in *Cybele*'s four volumes were based on his field collections and observations, complemented by his analysis of other floras, which had previously recorded the long-term residency of different species. In these observations, Watson criticized many other fellow botanists for not being cautious in ascribing 'native' status to species⁸. Those

⁸ 'Juvenile dabblers in botany and very superficial amateurs' and ill-informed writers not only encumber the literature of botany with their own blunders and valueless repetitions but they also disgust and deter more competent persons, whose writings might do real service to science' (Vol. IV, p. 522).

had acknowledged *Sempervivum*, a succulent, from the Americas, as 'alien' to Britain: 'This plant affords a fine instance of the proneness of human beings to follow blindfold any example once set, without taking the trouble to think whether it be right or wrong, wise or foolish' (Watson, 1847, p. 403).

In one example, Watson ranted no one before him

species he considered '*natives*' were undoubtedly '*indigenous citizens*' or those '*of aboriginal descent*', which existed in Britain before man's advent and influence.

He described two other categories - '*denizens*' and '*colonists*', contrasting those species with the '*aliens*'. '*Denizens*' do not need man's assistance but were inhabitants of particular places, surviving and perpetuating successfully. In his mind, such species were on well the way to becoming '*naturalized*', and some could easily be considered '*natives*'⁹. The term '*denizen*', however, did not survive subsequent botanical writings in the late-19th Century; it just simply disappeared with Watson.

In Volume IV of the *Cybele*, Watson devoted an entire, lengthy chapter of 60 pages, titled: "*On The Introduced Species*", to discuss the species he categorized as '*aliens*' (Watson, 1959, Chapter III, pp. 65-125). As Watson stated: '*The distinction between original 'natives' and 'introduced species' is of primary importance in geographical botany*' (p. 84).

In addition to the terms describing the '*civil status*' of plants, Watson described the '*habitat*' of those plants with another series of terms. Some of these, such as *littoral* (of the shorelines), *lacustral* (of lakes), *agrestal* (of agriculture), are used by ecologists even today, while others died out with age¹⁰.

For this essay, it is helpful to reflect on the examples of Watson's '*aliens*', which appear under '*Ornamental Garden Plants*' (pp. 74-77); '*American Species*' (pp. 77-79) and '*Wayside plants*' (pp. 82-83). All of them, in a strictly botanical sense, are colonizing species, which possess at least some of those attributes of Baker's '*Ideal Weed*' (see Baker, 1965) and thrive in disturbed areas, generally associated with human habitations.

Quoting, Watson:

'...The garden escapees rapidly propagate in a weed-like manner; occasionally passing thence into adjacent wilds, carried there by natural causes or the human agency...'

Among the '*American species*', Watson named many, which were unknown in Europe before America was discovered: '*they are 'natives' of the Western Continent, introduced into Europe by the human hand*'. Watson argued that a few of these species were well-advanced in '*naturalizing themselves among the natural vegetation*' and may even be accepted as '*true natives*' (Vol. IV, p. 77).

Under '*Wayside plants*', Watson discussed several modes of '*alien*' plant introductions to Britain. These included contaminated grain seeds, wool and other products, and accidental species introductions through: '*ships' ballast (returning coal vessels) thrown ashore from ships or intermingled with merchandise of various kinds*' (Vol. IV, p. 82). He also identified botanic gardens as a source, introducing plants, which may become '*occasional stragglers*' in Britain. In Table 2, I have given some examples of Watson's '*aliens*', drawn from *Cybele* Vol. IV, Chapter 3 with additional comments to exemplify the above points.

Watson doubted the '*native*' claims of many species by other botanists. Following extensive travels and collections, he spent considerable effort teasing out the introduced species from the indigenous British plants. The *Cybele* described many species that he had '*only ever recorded on areas greatly influenced by humans*' (viz. ornamental gardens). Some examples (Vol. IV, p. 76) include several Linnaean species, such as - common violet (*Viola odorata* L.); green hellebore (*Helleborus viridis* L.); periwinkle (*Vinca minor* L.), and stonecrop (*Sedum reflectum* L.; syn. *Petrosedum rupestre* (L.) P.V. Heath). The native ranges of such species are now accepted as Western, Central, Southern, and

⁹ The term denizen, from early 15th Century, refers to "a citizen, a dweller, an inhabitant," especially "a legally established inhabitant of a city or borough, a citizen as distinguished from a non-resident native or a foreigner". The origin of the English term is from Anglo-French: *deinzein* or *denzein*, meaning "one within" (referring to the privileges of a city franchise; opposed to foreign "one without").

The original Latin word is *deinz* "within, inside"; from Late Latin *deintus*, from *de-* "from" + *intus* "within". In legal term, a '*denizen*' could claim a right to become a permanent resident or citizen of a foreign country because of long-term occupancy of a place (source: <https://www.etymonline.com/word/denizen>)..

¹⁰ Among Watson's habitat categories (pg. 65-66) are terms, such as: (1) *agrestals* (growing in cultivated ground), (2) *viatical* (plants of road-sides

and rubbish heaps); (3) *lacustral* (plants immersed in water or floating), (4) *littoral* (plants of the sea-shore), (5) *sylvestral* (plants of wooded or shaded places), etc. These terms persist in modern usage as their meanings are self-evident, quite often, perhaps, without reference to or awareness of Watson's original definitions (Chew, 2006, p. 29).

However, a few habitat terms were too vague and never gained much currency. Examples are terms, such as (1) *ericetal* (plants of moors and heaths); (2) *uliginal* (plants of swamps, or boggy ground); (3) *paludal* (plants of marshy ground, the roots of which are in water or wet ground constantly); (4) *glareal* (plants of dry exposed ground, on gravel or sand); their usage died with Watson (Chew, 2006, p. 29).

Eastern Europe, stretching eastwards to the Baltic States. Watson's determinations about the 'alienness' of such species were indeed justified.

In the chapter '*On the Introduced Species*' (Watson, 1859, pp. 65-125), Watson provided stimulating discussions on '*denizens*' and '*colonists*', referring to many 'weedy species' that colonize and survive, year after year on disturbed habitat. Here, he pointed out that the distinction of '*denizens*' and '*colonists*' with '*aliens*' is a '*fine line*' only and vague as they overlap. The separation of species into categories is based on records of their frequent occurrence within established 'natural vegetation'.

He listed many British species as '*denizen*', which were well on the way to being '*naturalized*' after introductions, requiring no assistance from man to sustain their populations. He called them '*naturalized aliens*' and included many ornamental garden plants, especially fruit trees, such as a variety of *Prunus* L. spp. and medicinal and culinary herbs. After introductions, many such species have spread far and wide in Britain and can sustain themselves without man's aid, far away from human habitations (pp. 79-82), growing '*seemingly wild or spontaneously*'.

Table 2 Some examples of Watson's Aliens #, ##

Species/[Synonyms and Common Name]	Comments and Revised name#
<i>Allium ursinum</i> L. [wild garlic]	'never appears really wild, and in places remote from the abodes of man'; most of their localities are near existing houses'; The native range is West and Central Europe to the Caucasus ##
<i>Anacharis alsinastrum</i> Bab. [Canadian pondweed]	'The remarkably rapid increase and diffusion recently observed is familiar to all British botanists, though the plant was hardly known to any of them a quarter of a century ago'; A troublesome water weed of unknown origin from the Americas; [<i>Elodea canadensis</i> Michx.] ##
<i>Atropa bella-donna</i> L. [belladonna]	'is supposed to be native in some calcareous tracts, but many of its localities have a very suspicious proximity to old abbeys and monasteries'. The native range is West and Central Europe to the Caucasus from where it was introduced ##
<i>Barbarea preacox</i> (Sm.) R.Br. [land cress]	'certainly known to have been brought originally from America'; The native range is the Azores, South-West Europe to Central Italy and introduced to North America ##; possibly, an error from Watson; [<i>Barbarea verna</i> (Mill.) Asch.] ##
<i>Gnaphalium margaritaceum</i> L. [pearly everlasting]	'a plant of rapid increase by its underground suckers, pronounced native in Britain by several botanists on the faith of its apparent 'wildness' in some places; others assert it was originally introduced from America'; Now established as native to the Indian Subcontinent, Russian Far East and Japan; [<i>Anaphalis margaritacea</i> (L.) Benth & Hook.f.] ##
<i>Impatiens fulva</i> Nutt. [orange jewelweed]	'perfectly established in the county of Surrey, and perhaps through spreading along the course of the Thames river, it is becoming also established in Middlesex'; Native to North America, introduced to Europe and Britain; [<i>Impatiens capensis</i> Meerb.] ##
<i>Lysimachia ciliata</i> L. [hairy loosestrife]	'is stated to be likewise establishing itself in various spots, and with sufficient semblance of wildness to lead to mistakes, were its transatlantic origin not'; Native range Canada to the USA; introduced to Europe in the late-19 th Century ##
<i>Mimulus luteus</i> L. [monkeyflower]	'has become thus well established in many places, both in England and Scotland'; It grows in wet habitats (marshes and riverbanks). Native in North and South America; naturalized in Britain after first cultivation there ca. 1826; [<i>Erythranthe lutea</i> (L.) G.L.Nesom] ##.
<i>Oenothera biennis</i> L. [evening primrose]	'is less permanent, though become a half-wild weed in many spots'; A native of Eastern Canada, the USA to Mexico, introduced to Europe as an ornamental at least 350 years ago; widely naturalized in river banks, thickets and sandy places.##
<i>Oxalis stricta</i> L. [yellow woodsorrel]	'The very imperfectly established'- from America'; The native range is Central, Eastern China to North and Central Japan, all of North America; now cosmopolitan weed ##
<i>Spartina alterniflora</i> Loisel. [cordgrass]	'The locally well-established – from America'; Native to parts of North America; Northern and Southern parts of South America (Argentina); introduced to Europe, Asia, China, Australia, New Zealand; [<i>Sporobolus alterniflorus</i> (Loisel.) P.M.Peterson & Saarela] ##
<i>Vinca minor</i> [periwinkle]	'well adapted to spread over any favourable spot to which they are carried either by natural causes or by human agency'; Native range Europe to Caucasus #

Watson's descriptions are given in *Italics*, mostly from Volume IV pp. 70-80.

Additional notes from Kew Science Plants of the World On-Line: <http://www.plantsoftheworldonline.org/>

The common feature that links the listed '*alien*' species is that they are *all* introduced. Some thrive on continually disturbed agricultural habitat ('colonists') or 'stragglers' on shorelines, shipyards, waste dumps and other disturbed habitats. Others, including fruit trees, medicinal and culinary herbs, spread from ornamental gardens into even natural habitats.

Watson recognized that '*native*', '*denizen*', '*alien*' and '*casuals*' are merely terms that help describe the status, occurrence, and condition of a particular species, at a specific time in history. His words were:

"...the various grades of uncertainty or belief with respect to those plants whose aboriginal nativity is more or less unsettled. They also express a descending series, from the 'truly wild' and pre-historically established species, down to the occasional stragglers..."

(Watson, 1859, pp. 65-125)

Nearly 100 years before the discipline of *Weed Science* emerged, Watson referred to widespread agricultural weeds simply as '*colonists*' or '*casuals*'. He recorded the capacity of wild radish (*Raphanus raphanistrum* L.); rapeseed (*Brassica napus* L.; syn. *Brassica campestris* L.); and white mustard (*Sinapis alba* L.) to 'colonize' human-disturbed habitat (i.e., the agricultural field, home gardens and shipyards), and naturally disturbed habitat (i.e., shorelines).

In contrast to '*colonists*', those he called '*aliens*' included many horticultural species, e.g., cinnamon rose (*Rosa cinnamomea* L.); succulent sedums (*Sedum* L. spp.), or economically-useful species, e.g., flax (*Linum usitatissimum* L.); coriander (*Coriandrum sativum* L.); field eryngo (*Eryngium campestre* L.) and many clovers, e.g., Italian clover (*Trifolium incarnatum* L.); Persian clover (*T. resupinatum* L.); horehound (*Marrubium vulgare* L.). All had been accidentally introduced to Britain, and Watson noted that they often grew in disturbed habitats associated with human habitations (i.e., home gardens, ancient castles, abbeys, and monasteries)¹¹.

As Matthew Chew pointed out (Chew, 2006, p. 30-31), neither he nor Watson's biographer Frank Egerton found reason to suspect that the categories of species were '*essentially chauvinistic*'. I agree with Chew (2006), and may summarise, as follows:

(a) While stating "*the distinction between native and introduced species is absolute and real*", Watson

did not suggest the '*natives*' were inherently superior to any '*denizens*' or '*aliens*'.

(b) By describing his formula as one of "*civil claims*", and elsewhere, as "*predial*" (i.e., an archaic adjective relating to landholdings), Watson did seem to ascribe inclusion in the native British flora in combined terms of occupancy rights and a kind of botanical citizenship (Watson, 1859; p. 107).

(c) With time, 'the indications of foreign origin of many '*denizens*' would become *obliterated*, and it would be hard to distinguish them from the '*true natives*' as they will be '*naturalized*' over time.

(d) He saw '*naturalization*' as a natural process that leads to bio-geographical range expansion of many species. However, he made no comments on those '*naturalized*' species as causing undue concern to the extant British native vegetation.

(e) Watson also highlighted that '*alien*' species occupy corresponding climatic zones across regions in Britain as well as with the European landmass.

The *Compendium* (1870)

As diligent as ever, Watson dedicated the last decade of his life to revising and adding substantially to his earlier works. In 1870, he published a "*Compendium of the Cybele Britannica*", stating that:

"...The Compendium was a condensed reprint of the first three volumes of the original work, corrected to the more advanced knowledge of its subject in 1867-1869 (the years in which the three successively printed Parts), must largely supersede the scientific usefulness of the original work..." (Watson, 1870; p. 630)

Armed with new knowledge of plants and their distributions, Watson saw the necessity to reassess and modify his earlier works. Watson deserves credit for setting in motion what botanists nowadays call '*revisions*' of botanical works. Not every botanist, before the 20th Century, has had the time or resources to make such improvements.

Watson strongly believed that it was important for botanists to understand the '*factors*' that caused the changes in the biogeographical distribution of species. He was also keen to document the agencies (both human and natural), causes of spread and the

¹¹ Despite tedious efforts, some of Watson's '*civil status*' determinations were not always correct. One example is common bluebells (*Hyacinthus non-scriptus* L.), which Watson determined as an introduced species (Vol. IV, p. 76). However, its status has been revised as '*native*' to Britain and Western Europe (viz. Belgium, Netherlands, France, Portugal, and Spain). About half of the world's

bluebell populations occur in Britain, in woodlands, hedgerows, shady banks, on coastal cliffs and uplands. Bluebells (revised name: *Hyacinthoides non-scripta* (L.) Chouard ex Rothm.) are now '*naturalized*' in North America, and New Zealand (<http://powo.science.kew.org/taxon/urn:lsid:ipni.org:names:971733-1>).

habitat preferred by individual species, which successfully establish in the new environments.

However, he did not repeat his habitat classification of Volume I in the *Compendium*, possibly because it was more important for him to use the space for other aspects of geographical botany (Egerton, 2003). Nevertheless, with the updated terminology, Watson provided many more examples under the 'native', 'denizen', 'colonist', 'alien' and 'casuals' categories. Overall, in the final piece of his major works, Watson described just under 1500 plant species detailing many ambiguities in designating species to different categories.

Watson was undoubtedly a leading figure among the early botanists of the 19th Century who recognized the role of humans in moving plants across biogeographical regions. At the same time, he appreciated that natural agencies also cause long-dispersal of plants. Those days, the industrial revolution had begun to transform societies. The human population had also started to grow exponentially, and interactions across continents had greatly increased through trade, empire-building, conquests, and colonization of other continents (Crosby, 1986). Many plant species, the so-called 'aliens', spread widely, through human agency, partly by accident and partly by deliberate introductions. In describing these bio-geographical transformations and ecological changes, Watson's voluminous writings ascribe no blame to any species.

H. C. Watson (Figure 3), in later years of his long career, was indeed both a controversial and highly opinionated botanist. Often cantankerous in his writings and dismissive of others, he rarely praised anyone, except, perhaps, Alphonse De Candolle, who is invoked several times, but not always in a positive way (Egerton, 2003). His argumentative disposition did not endear him much to others.

Historical records, reviewed in detail by Egerton (1979; 2003; 2010), indicate that Alphonse De Candolle, Charles Darwin, and Joseph Hooker corresponded well with Watson and had a deep respect for Watson's tireless labours collecting plants and assiduous interpretations of plant distributions. For instance, Darwin praised Watson for not just indicating the number of species, which might be 'true'

but also for contributing ideas to the theory of evolution of species and quoted Watson up to 11 times in the *Origin of Species*.



Figure 3 Watson in later years (Source: <https://www.wikidata.org/wiki/Q1616636>)

As evident in *Cybele* Vol. 4 (1859) and the *Compendium* (1870), even towards the end of his career, he continued to be critical of studies of other botanists. Watson's biographer, Egerton (1979, p. 93), noted: "*Watson's botanical work was respected by his fellow British botanists, but since he often criticized their work, he had few friends among them*". Watson was not popular among botanists. His hard-nosed attitude and argumentative criticisms of other botanists permeate through all four volumes of the *Cybele* and the *Compendium*.

Although Watson's highly analytical discussions on species distributions set a benchmark for others, he paid scant regard to nor had access to fossil records of plants that existed in the British Isles. This deficiency may have affected his thinking in the well-documented public dispute with Edward Forbes, whom he resented¹². Watson quarrelled openly with Forbes, accusing him of plagiarism and not having the courtesy to acknowledge the '*rightful work of others*' (Watson's).

¹² A particularly noteworthy dispute Watson had with another scientist, Edward Forbes (1815-1854), is well-recorded in history and has been recently reviewed by Simone Fattorini (2017). Egerton (2003, p. 233) had earlier suggested that the virulence of Watson's personal attacks on Forbes was far beyond a scientific dispute. It showed that Watson

was afflicted by "a lifelong personality disorder". Recorded history suggested that Watson was resentful of Forbes because the latter (a talented zoologist and palaeontologist, but not an eminent botanist) had, in 1842, beaten Watson in a contest for the chair of botany at the University of London.

A deeper analysis of the Watson-Forbes dispute is beyond this essay. Still, it is evident that, apart from studying the extant British flora, Forbes had indeed used geological data and information in proposing his theory¹³. Based on his analysis, Forbes classified the British vegetation into five zones rather than six, as Watson had suggested (Egerton, 2010, pp. 187–188). Watson had previously divided the British vegetation into three regions, each subdivided into two zones, a total of six zones (Egerton, 1979, p. 91) and felt insulted. Watson also saw Forbes' classification as a challenge to his determinations (see Fattorini, 2017 for a fuller discussion of the dispute).

In subsequent decades, and most certainly, 100 years later, the *Cybele* received appreciation in Britain as a highly significant achievement, which laid the foundation for British Botany (Egerton, 1979; 2003; 2010). Recognized as the first, earnest attempt to put geographical botany on a scientific basis, botanists now acknowledge that the *Cybele* contributed more to British botany than all the outpourings of 'poetic-floristic flummery' put together in previous decades.

The *Botanical Society of Britain & Ireland* (BSBI) honoured Watson by naming their Journal – *Watsonia*, published from 1948 until 2010; this Journal is now the *New Journal of Botany*. In the first issue of the Journal, Meikel (1948) wrote:

"...the Cybele replaced vague generalizations with concrete facts about the character of the British flora. Previous botanical treatise had been just mere catalogues of plants and localities, with no effort made to discriminate between 'native' or 'alien' species, nor to determine their distribution, vertical or horizontal..."

Honouring Watson, the BSBI¹⁴ currently maintains a large collection of Watson's specimens as a digital library. The pages dedicated to Watson have extensive notes and a digital map of where he made the collections (Figure 3). The website provides photographs of many of Watson's original herbarium specimens, preserved in various institutions.

Watson's contributions may have also influenced the founders of *Weed Science*, such as George Baker (Baker, 1965). The discipline now understands why

colonizing species are widespread (mostly spread by the human agency), and in the habitat types, such taxa dominate. However, an analysis of botanical literature shows that Watson's original terminology, including the term 'alien', was not widely adopted by other botanists except Stephen Dunn (1905; see below) and, more recently, Salisbury (1961).

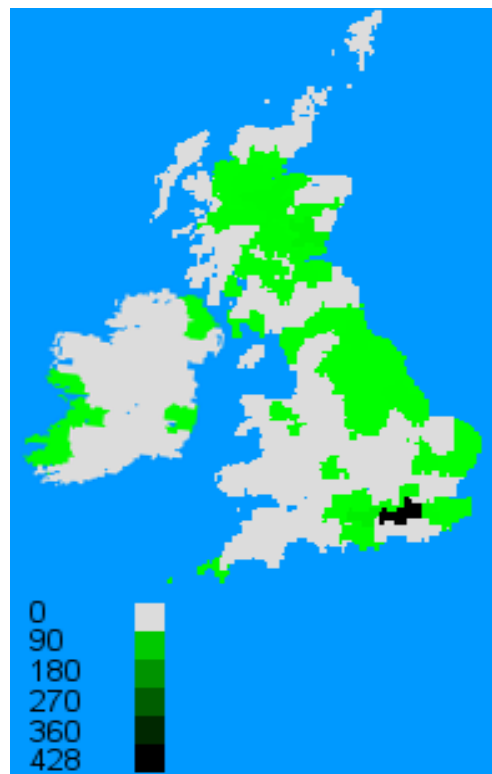


Figure 4 A digital distribution Map of Watson's collections (Total No. of species: 1328)

Stephen Dunn and the British 'Alien' Flora

Following H.C. Watson, one of the earliest British botanists who popularised the term 'alien' was the British taxonomist Stephen Troyte Dunn (1868-1938). Dunn worked at the Kew Herbarium and served as the superintendent in the Department of Botany and Forestry (1903-1910) in Hong Kong. At Kew, Dunn would have examined large collections of specimens stored at the Herbarium¹⁵.

¹³ Egerton (2003) noted that Forbes' botanical production was rather limited (especially if compared with that of Watson). Nevertheless, Forbes became the Professor of Botany at the University of London in 1842 much to Watson's resentment. Because Forbes' professorship salary was not sufficient, he also worked for the Geological Survey of Great Britain as a palaeontologist. Undoubtedly, Forbes used the geological data he had as an advantage.

¹⁴ Herbaria@home The digital library is available at:

<http://herbariaunited.org/core/specimenssearch.php?collector=Mr+Hewett+Cottrell+Watson&colid=2696&search=search&start=160&#searchlist>

¹⁵ Dunn's association with Kew lasted about 30 years. He was an Assistant in the Herbarium for India (1901-1903); before becoming Superintendent of the Botany & Forestry Department, Hong Kong (1903-1910). Dunn had also worked on compiling the 2nd supplement of the *Index Kewensis* (1913-1915) and assisted J. S. Gamble in the preparation of the *Flora*

Just as much as Watson wrestled with designating species as 'native' or 'alien', Dunn (Figure 4), too, laboured in categorizing plant species in this way without extensive knowledge of historical plant distributions and current phyto-geography.

In the introduction to his book – "*Alien Flora of Britain*" (Dunn, 1905, p. vii), Dunn clarified that: "*The term alien is used to designate any species which, though now spontaneous, originated in Britain through the human agency*". The definition shows that Watson and Dunn categorized 'alien' species simply as plants 'introduced' by man. Agreeing further with Watson, Dunn said: "*it is seldom possible to obtain any definite information as to the manner in which they actually arrived in the country*".



Figure 5. A rare photograph of S. T. Dunn from Kew Archives

'Aliens' and 'Unnatural Habitat'

The following passage shows Dunn's thoughts on 'alien' species went further than those of Watson:

"...The term "introduced plant" is not really distinctive, for all plants, native and otherwise, must have been originally introduced to their present habitats. In the great majority of cases, botanists arrive at their conclusions as to the status of a species by a careful

observation of its present circumstances in the British Isles, and also of its geographical distribution beyond them..."

"...Thus, a species which exists in perfectly wild and natural surroundings, both here and in the neighbouring parts of the world, is deemed 'indigenous', for there is no reason to suppose that its presence is due to any agent but natural dissemination at the time when the flora of North-West Europe originated..."

"...If, on the other hand, a species is always found to be connected with artificial surroundings, it is classed as an 'alien'..."

From his viewpoint, 'unnatural habitat' (i.e. disturbed areas, affected by humans) was 'what botanists must chiefly rely on to distinguish the true alien' (Dunn, 1905, p. x). Such areas were affected by the human hand and human habitations, e.g., home gardens, agricultural land, waste dumps, roads, railway tracks. Dunn also included pastures and other areas affected by the waste of domesticated animals, pointing out that grazing (viz. disturbances) 'artificially' changes the naturally existing flora.

Regarding species occupying areas of 'natural waste', such as the haunts of wild animals, he reasoned that: '*they offer much the same conditions as those of domesticated cattle, and the natural waste ground flora has been carried on by artificial conditions*' and favoured designating species found on a natural waste site also among the 'aliens'.

Dunn (1905, p. iix) emphasized how difficult "*the problem presented by some plants, which abundantly accompany human operations but also occasionally appear in wild habitats in their neighbourhood*". He then classified the '*better-established aliens*' under the special 'artificial habitats' they inhabit and affect.

"...Thus, those which inhabit roadsides are sometimes known as viatical weeds, those of cultivated fields called agrestal, and so on, but the classes are not clearly enough defined to derive much elucidation from these terms..."

Dunn's writings on 'alien' species are clear on the role of humans in both species introductions and in creating habitat conditions under which some species thrive and spread widely even into a natural habitat and establish ('naturalized'). While some species can grow spontaneously ('wild'), becoming independent of man, others depend on disturbances caused by man's activities for existence.

of the Presidency of Madras. He then visited America and on his return was re-appointed at Kew as Assistant for India (1919-1925). From 1925-1928 he acted as a Botanist in the herbarium [Sources: (1)

https://en.wikipedia.org/wiki/Stephen_Troyte_Dunn); (2) Kew Archives: S. T. Dunn at Kew (<https://www.kew.org/read-and-watch/on-the-min>)].

He wrote:

"...In artificial habitat, accompanying human operations, some plants seem especially to take advantage of the (mechanical) disturbance of the ground and the unnatural supply of plant food. Cultivated fields, again, with their abundance of plant-food, harbour all sort of weeds, but only those gain permanence which by quick seeding can withstand the frequent ploughings..." (Dunn, 1905, p. xi).

On 'Natives'

In sharp contrast to the 'alien' flora, Dunn's 'natives' were: 'species, which occurred in a natural locality to which it has spread by natural means from a natural source; that is, when it has been disseminated as it would be in a state of absolute nature'. He stated the spread of plants by water, wind and birds as 'natural means' (Dunn, 1905, p. ix-x).

Dunn, therefore, used the evidence of long-term residency, spread by *natural* means and the abundant occurrence of a species in association with a specific (natural) habitat, as characteristics of identifying it as a 'native' (Dunn, 1905, p. ix). However, he did not favour calling 'native' species 'aboriginal' because:

"...it implies a knowledge of the history of species, which we seldom possess. If the term "aboriginal" were substituted for "native", in many of our local Floras, expressions such as "native on walls, and by roadsides" and "native in hedgebanks" would be inconsistent, for no species could be aboriginal in these situations..." (Dunn, 1905, p. ix)

Introducing agents

Dunn (1905, pp. xiii-xvi) agreed with Watson that economic activities of humans; viz. ships' ballast (including coal ships) and the importation of materials, such as agricultural seeds, flour-making grains, bird-feed seeds, hay, wool, skin, hides and furs, were the primary sources of most 'alien' weeds¹⁶.

Dating back to at least the 14th Century (Dunn, 1905, p. xiv), he cited many species whose 'native' ranges were outside Britain, ranging to Eastern Europe and also as far as Western Asia (the orient). Invoking Watson's 'stragglers' and 'casuals', whose presence was always transient in disturbed habitat, Dunn agreed that constant re-introductions were

necessary for such species to maintain their presence (Dunn, 1905, p. xiii).

"...By far, the most important agent of plant introduction at the present time is the importation from foreign countries of the kinds of grain, which are most largely used for making flour and for distilleries. In every sack, countless seeds of the corn-field weeds of the country of origin come mixed with the grain."

"...Before the grain is used, these seeds are sifted out and are either thrown away with other rubbish on waste ground or sold for feeding domestic fowls and game. In the former case, astonishing crops of exotic weeds may be produced in a small area, and some of them will possibly survive and become established there for a time..."

"...In the second case, the aliens will spring up here and there around cottages, along roadsides, in coppices, or wherever the birds fed. All the species introduced in this way must be 'corn-field weeds'. It should be remembered that corn has been continuously imported since the 14th Century at least and that some of our oldest recorded weeds may be due to this source..." (Dunn, 1905, p. xiii)

As stated in the *Summary* (p. xv), Dunn enumerated 924 'introduced species' as 'aliens' in the British Flora. He categorized: (a) 123 as 'old-established weeds of uncertain origin'; (b) 332 as introduced through horticulture and arboriculture; (c) 206 are 'casual', 'grain-sifting' aliens of recent appearance and little permanence'.

The *Summary* also refers to 170 other species, 'indicated in square brackets, the greater number are common weeds, recorded from artificial habitats only, but which the author believes to be true natives'¹⁷.

Dunn pays tribute to the Herbarium and library of Kew, saying: 'The work could hardly have been done in any less completely equipped establishment, for it has been necessary to obtain details of the native area of British plants over the greater part of Europe and Western Asia...'. In the acknowledgement, much like Watson did, Dunn, too, pointed to the absence of relevant bio-geographical information in the floras:

"...And the existing compilations upon the subject afforded little help. In them, no discrimination is attempted between the truly native area and the area over which the plants are wild. Reference has therefore been

¹⁶ Despite the numerous wars and the movements of ships, transporting both soldiers and military equipment, Watson and Dunn do not refer to this contamination pathway as an 'introducing agent' of weedy taxa to Britain.

¹⁷ The *Summary* does not state what the other 93 species are but a presumption that they were considered by Dunn as already 'native' to or well on the way to becoming 'naturalized' in at least some parts of the British Isles appears valid.

necessary to individual foreign local Floras in order to ascertain the exact habitats and status of each species...." Dunn (1905, p. xv)

In the book, Dunn acknowledged Watson's *Cybele* and various other publications, especially articles in the *Journal of Botany*, notes (preserved in the Botany Department of the British Museum) and Watson's herbaria (held at Kew), along with Alphonse De Candolle's *Géographie Botanique*, among the sources he studied. Although Dunn does not state explicitly, it is clear that he followed much of Watson's reasoning regarding how to distinguish between 'true natives' vs 'introduced species'.

However, Dunn jettisoned the term 'denizen' completely, preferring to lump Watson's 'colonists' and 'casuals' as 'aliens', which follow human-caused disturbances (i.e. they were species, which did not generally grow in habitat unaffected or independent of human-caused disturbances). He also applied the term 'wild' to all plants adapted to grow spontaneously without the aid of the human hand (i.e. *naturalized*).

With his studies on other floras, Dunn differed from Watson's determinations of 'nativeness' of several species (i.e., *Viola*, *Brassica*, *Anthemis*, *Cotula barbata*), favouring to list them as '*naturalized aliens*'. Revisions, such as those, are not uncommon in botany, as additional information on the biogeographical distributions of species become available based on fossil records and their current abundances elsewhere.

My analysis shows that Watson's 'aliens' and Dunn's 'aliens' were merely introduced species with special attributes to spread widely. Interestingly, neither botanist called these 'exotics' – a term that crept into the botanical jargon in subsequent decades¹⁸. Their ideas converge on many aspects. For instance, in the absence of much geological evidence, both (erroneously) believed that the 'alien' species did not arrive in Britain independently of humans, nor could many of them exist without man's help. Watson implied, and Dunn named it by stating: '*Artificial habitat*' conditions were essential for the 'aliens' to establish. They agreed that, over time, the identities of many 'aliens' would be so 'obliterated', and it would be hard to distinguish them from '*true natives*'.

Subsequent geological research, of peat deposits and organic matter from bogs and lake basins formed during the ice ages (see below) proved that many of the extant 'weedy' species did arrive in the British Isles via natural agencies when the sea

levels were much lower in the North Sea, and the English Channel and the islands were connected to the European landmass (Godwin, 1960). After the first establishment, it is unlikely that any pioneering species ever fully 'disappeared' from the flora, except perhaps from very localized areas.

Although species transformations and evolution were not major themes for the two botanists, both drew attention to closely allied species, which may have evolved from common ancestors.

Almost a century after Watson and at least 50 years after Dunn, our founders (Bunting, 1960; Baker, 1965) recognized: the common attributes (adaptations) of colonizing taxa; the critical role of human-caused and natural disturbances in the success of such taxa; and the environmental factors, which are conducive to their establishment. In discussions of the evolution of 'weeds', the possibilities of crossing between closely-allied species are also widely acknowledged.

Apart from commenting on the abundance of species in a specific habitat and spreading wildly, neither botanist wrote about 'ecological explosions' or 'habitat invasions' attributed to the 'aliens'. The current knowledge of the history of ecology enables us to suggest that ecological studies of the potential effects of introduced species came after the eras of both botanists. However, some foundational ideas on weeds – that of human-caused habitat disturbances (including agriculture) and the direct role of humans in the global spread of colonizing taxa - can certainly be attributed, at least in part, to their diligent research.

The Post-Watson-Dunn Era

When they collected and examined common and rare species and studied where they occurred, the focus of those industrious 18th Century botanists was firmly on species, which formed the extant British flora. While attributing nearly all of the 'aliens' to human introductions and human-disturbed habitat, Watson and Dunn were acutely aware that even the so-called 'aboriginal natives' may have also been immigrants into the British Isles, at different dates, from other lands, at some ancient geological times.

Discussing how and why plant species got to where they are currently distributed (i.e. geographical botany), Watson was handicapped by the lack of geological data, such as continental drifts and changes in sea levels during the past ice ages.

¹⁸ 'Exotic' – a term dating back to the 16th Century, directly from Latin *exoticus*, means "foreign" literally "from the outside", "belonging to another country"; it was used in 1620s in referring to 'exotic' strip-

teasers and dancing girls; the term is nowadays used to refer to 'foreign' introduced plants.

Importantly, Watson's *Cybele* and Dunn's '*Alien Flora*' are notably devoid of slander of plant species. Even implicitly, they did not write about 'alien invasions'. Without hyperbole, they wrote on the species' ranges, climatic and other factors that cause plant distributions to expand across continents. A secondary motive, especially with Dunn, might have been to caution other botanists on the risks associated with plant introductions, purposely or accidentally. In the latter part of the 19th Century, as the British Empire grew, Dunn was much aware of the exchanges of live specimens among botanic gardens and enthusiastic plant collectors.

My analysis shows that the absence of geological evidence, such as fossil deposits, pollen analysis, and carbon dating, impeded the determinations of mostly of Watson, and to a lesser extent, Dunn. By mid-20th Century, scientific advances enabled such data and information to establish the origins and history of the 'aliens', specifically, the weedy flora in Britain.

Harry Godwin (1901-1985), a high-profile English botanist, ecologist and 'peatland scientist' who worked at Cambridge, stands prominent in this regard¹⁹. Later knighted for his work, Godwin was the founder and first Director of the Sub-department of Quaternary Research at Cambridge in 1948 and is acknowledged as the pioneer of the new radio-carbon dating technique of fossils. Godwin's laboratory examined pre-historic deposits from specific sites combining both geological and biological techniques. These included examining fossil impressions in clay and mineral deposits, microscopic pollen identification (palynology), radio-carbon dating, and macroscopic identification of genera and species through carbonized fruits, seeds, and tubers.

Godwin (1960) rejected the view that '*those unwelcome occupants of pasture, wayside and cultivated land*' and '*habitual camp followers*' had entered the country with Neolithic farming in the Bronze Age (3100-1200 BC)²⁰. His analyses showed that the entry of many British weeds and ruderals, mainly from the European continent, was long before Neolithic agriculturists entered Britain. Geological

evidence suggested that due to the lowering of the ocean level, the southern North Sea was dry throughout the Late-glacial and early Post-glacial periods. As a result, '*the natural migration to and from the Continental mainland was far easier than it afterwards became*' (Godwin, 1960, p. 4).

Expanding weed populations, well before the Bronze Age included many ruderal species, such as mugworts (*Artemisia* L. sp.), nettle (*Urtica* L. sp.), plantain (*Plantago major* L. or *P. media* L.), docks (*Rumex*), clover (*Trifolium*), fairy flax (*Linum catharticum* L.); perennial knawel (*Scleranthus perennis* L.), cornflower (*Centaurea cyanus* L.), lesser knapweed (*Centaurea nigra* L.), *Chenopodium* L. spp., spear thistle [*Cirsium vulgare* (Savi.) Ten.], and musk thistle (*Cardus nutans* L.). Such species survived in the Late-glacial vegetation, dating back to the last Ice Age (ca. 12,000 years ago)²¹.

Godwin (1960) highlighted man's role in clearing forests and conversion of the countryside to agriculture and the construction of drainage and road networks, built during the Roman (ca. 55 BC-410 AD) and Anglo-Saxon (ca. 410–1066 AD) periods in Britain²², as the primary causes of the spread of weedy species in those ancient times. The geological evidence examined has proven that deforestation in Britain began in Neolithic times (about 12,000 years ago) and intensified in the Bronze Age, Iron Age (ca. 1200 BC -100 AD) and subsequent times.

Romans introduced many 'exotic' species from continental Europe for food, flavourings, cosmetics, or other purposes. Examples are - fruit trees [e.g., black mulberry (*Morus nigra* L.); plums (*Prunus domestica* L.); vine (*Vitis vinifera* L.); fig (*Ficus carica* L.)]; vegetables [e.g., parsnips (*Pastinaca sativa* L.), peas (*Pisum sativum* L.); beans (*Vicia* L. spp.); wild radish (*Raphanis raphanistrum* L.)]; spices [e.g., fennel (*Foeniculum vulgare* Mill.); coriander (*Coriandrum sativum* L.); dill (*Peucedamun graveolens* (L.) Hiern.)]; and medicinals [e.g., belladonna (*Atropa belladonna* L.)]. Godwin (1960) also suggested that some of these later established as ruderals, while others may have failed. However, such introductions

¹⁹ Harry Godwin, Professor of Botany, Cambridge University (1960-67); Editor of *New Phytologist* (1931-61); and *Journal of Ecology* (1948-56) (https://en.wikipedia.org/wiki/Harry_Godwin).

²⁰ Godwin's important contribution was made at the 1959 Symposium on: *The Biology of Weeds*. Ideas about the need to better appreciate weed biology and ecology came around in the late-1950s. Leading the effort, John Harper (Oxford University) organized the symposium under the auspices of the *British Ecological Society*, at Oxford, April 2-4, 1959. This seminal event turned the attention of weed

researchers to focus more on the origin, evolution, taxonomy, biology and ecology of weeds, including their reproductive systems and habitat preferences.

²¹ The most recent glaciation period peaked 18,000 years ago before the interglacial Holocene period began 11,700 years ago (Source: https://en.wikipedia.org/wiki/Last_Glacial_Period).

²² Sources: (1) <https://www.historic-uk.com/HistoryUK/HistoryofBritain/Timeline-of-Roman-Britain/>; (2) <https://www.history.org.uk/primary/resource/3865/anglo-saxons-a-brief-history>.

must have been accompanied adventitiously by many species now part of the British flora.

Five decades after Dunn, in a period disrupted by two World Wars, Edward Salisbury (1886-1978)²³, a Professor of Botany at the University College, London, re-invented the term '*alien*'. Somewhat unfortunately, his book was titled "*Weeds & Aliens*" (1961). During 1943-56, Salisbury was also the Director of Kew Gardens in London, at the height of World War II and what followed. He, too, had access to century-old herbarium specimens at Kew and other Herbaria and considerable interest in weeds.

A book, so provocatively entitled, published while the discipline of *Weed Science* was just about taking shape in the late-1950s and early-1960s, would have had an impact. However, other scientists cautiously avoided the term for many decades until it was again re-invented by the more recent '*invasion*' narrative.

Salisbury likely meant to follow Watson and Dunn and used the term '*alien*' interchangeably with '*introduced*'. Nowadays, some authors use the term to refer to plants becoming weedy when transferred from their native to an *alien* environment, meaning a new environment. Here, while the emphasis is on the new environment, the organism is also regrettably branded with unfavourable undertones, an *alien foreigner*²⁴.

By combining the terms '*weeds*' and '*aliens*', Salisbury's book directly spoke to the fear people had of squatters and homeless people, who were plentiful in London during World War II. Floods of refugees entered Britain from Europe due to the massive displacement of people during the war. Salisbury's words may have reflected such fears of 'foreign' immigrants and widely-prevalent attitudes at that time, depicted in many books and films. Still, you could excuse the layperson for being confused!

Inadvertently, Salisbury had given those human adversaries of weeds who want 100% control of colonizing species the perfect weapon! Taking the cue from him, other senior botanists have also used the term. Hiram Wild, a renowned botanist from South Africa, in 1967, published a paper on '*Weeds and*

Aliens' in Africa and their origin as '*American Immigrants*' (Wild, 1967). Peter Kloot, an Australian botanist, also borrowed the term in discussing plants from overseas, now naturalized in South Australia (Kloot, 1983). The term '*alien*' was superfluous in both these articles for their key botanical messages.

My view is that the word '*alien*', prone to misinterpretation, was then, and even now, is superfluous to enlightened discourses on colonizing taxa. Alongside the absurd militaristic metaphors (viz. '*enemies*'; '*invasions*', '*invading armies*') are relics of the past (see Darlington, 1859; Evans, 2002²⁵) '*alien*' is a term best avoided in dealing with such species.

Alien Plants of Australia

Peter Michael (1994), an Australian botanist, and taxonomist contributed to understanding how the term '*alien*' has been used. He simply followed Watson's definition and focused on species introduced to Australia from other regions and their possible origins based on available records. Stating how difficult it is to establish whether a particular species is '*native*' or '*alien*', he explained:

"...In Australia, as in other countries, a high proportion of the 'alien species' are weeds of cultivation, pastures, roadsides, and waste places. These weedy aliens may be called pioneer species because of their ability to colonize disturbed or denuded land. During the history of land development in Australia, relatively few native species have behaved in this way..." Michael (1994)

As both Watson and Dunn did, Michael noted that many such '*alien*' species were strongly associated with man's activities (viz. settlement, cultivation, home gardens, roadsides, waste places). Some arrived in Australia accidentally along with crop and pasture seeds; others were introduced intentionally.

Quoting Darlington (1963), he pointed out that the '*alien*' species, in general, could be traced back to the regions of origin of crop plants (i.e., South-West, Central and South-East Asia, the Mediterranean, Europe, Central Africa, the USA and Peru, Chile, Brazil and Paraguay in South America). Those that

survive and subsequently reproduce'.

'An Invasive Alien Species is an alien species, which becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity'.

²⁵ Clinton Evans' environmental history book – "*War On Weeds In The Prairie West*" gives a detailed account of the evolution of war-like rhetoric and the hardline attitudes towards weeds in North America.

²³ E. J. Salisbury (See: https://en.wikipedia.org/wiki/Edward_James_Salisbury).

²⁴ The International Union for Conservation of Nature (IUCN) describes '*aliens*' as follows:

'An Introduced or Alien species means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e., outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans). It includes any part, gametes or propagule of such species that might

are sufficiently well established ('naturalized') are widespread and occupy vast areas of the Australian continent. Such species can be considered '*true constituents of the Australian flora*' (Michael, 1994).

He also pointed out that some species, such as creeping woodsorrel (*Oxalis corniculata* L.), in the broad sense, are represented by both '*alien*' and '*native*' forms. Many of the '*alien*' species in Australia are also found in a wide range of naturalized floras throughout the world, as Michael (1994) pointed out.

As an example of an '*alien*', apparently '*invading*' undisturbed native vegetation of Australia, Michael (1994, p. 51) stated the studies of Westman, Panetta and Stanley (1975) on the occurrence of groundsel bush (*Baccharis halimifolia* L.) in uncleared swamps of swamp oak [*Melaleuca quinquenervia* (Cav.) S.T. Blake]. However, such marshes would likely have been continually disturbed by inundation and wetting and drying cycles.

Conclusions

As Watson and Dunn so clearly enunciated, humans, species introductions and disturbed habitat associated with humans were the key aspects of calling a species '*alien*'. There is little doubt that Watson was the primary initiator of the term in botanical literature. However, he applied it only to describe some species in the British Isles that he could not ascribe to other categories.

Watson's '*aliens*' were '*immigrants*', the greatest majority of which were introduced by accident from Europe, Asia, and the Americas. Despite other contemporary botanists of the era avoiding Watson's terms, the adoption of the word '*alien*' by Dunn in the title of his book gave the term increased credibility.

Watson, unknowingly, set in motion a trend that he could easily have avoided. Some decades after Watson, Dunn, a much-respected botanist of the '*Empire*', expanded the meaning of the term '*alien*' to include many taxa that Watson had previously categorized as '*colonists*' in agricultural landscapes and '*casuals*' at disturbed sites. Dunn, too, could have avoided the term without losing the substantive value of what he wrote. Both could have, instead, just referred to such species as '*introduced plants*', which might be considered a relatively neutral clear-cut term, without prejudices and bias.

The term '*alien*' is applied nowadays to both animals and plants with little regard for what it means, its implications, or why scientists of the past centuries used the term. In Matthew Chew's opinion (*pers. comm.*, 19 June 2021), there is no chain of credible

historical evidence to show that the term '*alien*' was appropriated by Salisbury or those who followed.

It is still important for weed researchers to note that as the discipline of *Weed Science* was taking shape, in the crucially important *Weed Biology Symposium* of 1959, eminent scientists, led by John Harper (1960), discussed introduced species and various other weeds without referring to them as '*aliens*'. They avoided exaggeration.

While all botanists and ecologists should appreciate H.C. Watson and S.T. Dunn for their colossal botanical contributions, their popularisation of the term '*alien*' may have inadvertently given a perfect weapon to the human adversaries of weeds to treat these highly resourceful organisms with contempt. Negative assumptions on weeds, formed over two centuries in agriculture, have hindered ecologically oriented weed research in areas outside agriculture. Weedy species are not our '*enemies*', nor are they '*aliens*'. Such negative and definitive terms narrow our vision. Their use, alongside the rampant use of war-like messaging, are unlikely to assist any society in managing colonizing taxa in any situation.

I believe that rallying the public to manage the adverse effects of any colonizing species, introduced to regions away from their native ranges, should be done best with a deeper ecological understanding of individual species rather than confusing terminology. Management should also keep an eye out for economic, environmental, and social implications, without dramatizing issues, and avoid messages that create a visceral dislike for the colonizing plant taxa.

In concluding, I reiterate that ***weedy species are no more alien or villainous than man himself***. With or without humans on the planet, colonizing species will play vital roles in stabilizing the earth's damaged ecosystems, as pointed out by Alfred Crosby (see quote on p. 1). They will also survive any catastrophe on the planet much better than humans would.

To end this essay, I refer to two important quotes, which inspire me every day. Perhaps, other weed scientists may also see weeds and the world in that way? I certainly hope so.

"...Justice requires, in the case of plants and persons, everyone shall be innocent until they are proven guilty of wrong..." Gerald McCarthy (1892)

"...Those who cannot remember the past are condemned to repeat it..." George Santayana (1906, p. 284)

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